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Preface

This issue contains papers that were originally presented at the Seventh International Workshop on the Practical Application of Stochastic Modelling (PASM) held in Newcastle-upon-Tyne (UK) in May 2014. This workshop was collocated with the Tenth European Dependable Computing Conference (EDCC).

PASM follows in a long tradition of the application of stochastic modelling to real-world problems. Such models have led to significant advances in modelling theory, as well as insights into the specific problem areas concerned. Coming from a computer science background, PASM is particularly concerned with applications of specification and analysis techniques and tools developed for computer science, as well as computing and communications applications. In particular, the aim of PASM is to give a forum for which applies current well-developed formalisms (stochastic Petri nets, stochastic process algebras, layered queueing networks, etc) to real-world case-studies.

The papers in this issue cover a broad range of research in the area of stochastic modelling and performance evaluation and involve both applications and theory to enable practical application of techniques. These studies are not only of traditional computing applications, but also from inter-disciplinary collaborations in transport and infrastructure, as well as other aspects of non-functional analysis, such as security properties and energy efficiency. These links are particularly relevant at this time as we experience a convergence of methods and cross-fertilisation of ideas between previously distinct communities working on common problems of environmental impact. Successful contributions have demonstrated some novel theoretic advance to model their system or will have been diligent in constructing a detailed and realistic model and carried the modelling through to the analysis phase. This results in a collection of papers which could be used as examples of outstanding practise in the field of formal stochastic modelling and performance evaluation.

Polansky *et al* consider the problem of optimal speed-scaling for processors with variable speeds. The system is modelled as a fluid queueing model with load-dependent service rates, which is achieved by splitting the fluid range into intervals and selecting a service rate for each interval. Optimal thresholds are determined to select the processor speed according to the offered workload in order to minimize the energy consumption.

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Gribaudo *et al* present a novel line of work concerning the modelling of attacks on infrastructure. The approach used is to translate from attack trees into Bayesian networks, which can then be analysed to identify (and quantify) potential threats. This approach allows domain specialists to analyse their system using attach trees, before translating the model to a Bayesian network in order to utilise existing solution tools. The approach is illustrated using an example drawn from rail transportation.

Montecchi *et al* investigate the trade-off between security and other, non-functional system attributes, which is an area of considerable practical interest and theoretical challenge. The approach used here is to form a model of the OPENESS platform (a thin client application over a network with proxy servers) using stochastic activity networks (SANs). Different profiles are set up for different types of user and results are derived for parameters drawn from the published literature.

Avritzer *et al* introduce a novel model of critical city infrastructure survivability after a disaster has occurred. The reliability and recovery of such *cyber-physical systems* is of considerable practical relevance, although there are considerable difficulties in constructing and analysing such models. The authors present an overview of three approaches which highlight the challenges within this demanding application domain for modelling.

Bortolussi *et al* consider a model of nested automata in a so-called *system of systems*, with automata contained in other automata. The state space of such nested Markov models are generally significant, hence a simpler model is constructed and then a fluid approximation is applied based on a system of ordinary differential equations. The accuracy of the fluid approximation under steady state behaviour is then explored through a case study.

Vissat *et al* present a novel model of bus movement along a single route within the city of Edinburgh. They use the HyperStar tool to fit an Erlang distribution to real-time GPS data of bus position and analyse the resulting model using the PRiSM model checking tool. The model is used to predict where delays are likely to occur and hence a new timetable is proposed which would minimise late or early arrivals.

Reijsbergen *et al* also study bus punctuality within Edinburgh. The focus here is to use Automatic Vehicle Location (AVL) data and HyperStar to derive distributions of bus sojourns within 'patches' or local areas. The objectives are to determine whether the existing bus provision is adequate and to assess the impact of proposed changes, such as the introduction of a tram system within the city.

Cerotti *et al* analyse different replication policies to improve performance in a cloud computing environment. The use of such policies is to balance the desire for a reliable fast performance for a single replicated service, against the increase in demand arising resulting from replicating many services. The system is modelled using multiclass queueing networks and analysed using mean value techniques. The results presented illustrate the point that optimising one objective function may have a detrimental impact on another.

Forshaw *et al* present a study of energy efficient checkpointing in a large multi-

user computer system. The study is based on trace driven simulations, where the traces are real user jobs deployed to a Condor pool. Checkpointing is used to preserve work undertaken on tasks which might not complete for some reason. Various policies are proposed and investigated for the efficient deployment of checkpointing, with particular emphasis on understanding their relative performance and energy characteristics.

This is certainly a varied and interesting set of papers, and we are indebted to the authors for their dedication and for choosing to present their work at PASM. The organisation of events such as these is a team effort and we have learnt to choose our team carefully. We would like to extend our thanks to the organisers of EDCC for all the practical arrangements on the day of the workshop and to the members of the PASM programme committee, who thoroughly refereed all the submissions and made some difficult choices easier by their detailed comments.

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